

SEQUENCE LISTING

<110> Nielsen, Bjarne Roenfeldt
Svendsen, Allan
Pedersen, Henrik
Vind, Jesper
Hendriksen, Hanne Vang
Frandsen, Torben Peter

<120> Glucoamylase Variants

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<140> 09/351,814

<141> 1999-07-12

<150> PA 1998 00937

<151> 1998-07-15

<150> PA 1998 01667

<151> 1998-12-17

<150> 60/093,528

<151> 1998-07-21

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<151> 1999-01-12

<160> 81

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<222> (73)...(1602)

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Leu Ala Asn Val Ile Ser Lys Arg Ala Thr Leu Asp Ser Trp Leu Ser	
-5 1 5	
aac gaa gcg acc gtg gct cgt act gcc atc ctg aat aac atc ggg gcg	144
Asn Glu Ala Thr Val Ala Arg Thr Ala Ile Leu Asn Asn Ile Gly Ala	
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gac ggt gct tgg gtg tgc ggc gcg gac tct ggc att gtc gtt gct agt	192
Asp Gly Ala Trp Val Ser Gly Ala Asp Ser Gly Ile Val Val Ala Ser	
25 30 35 40	

ccc agc acg gat aac ccg gac tac ttc tac acc tgg act cgc gac tct 240
Pro Ser Thr Asp Asn Pro Asp Tyr Phe Tyr Thr Trp Thr Arg Asp Ser
45 50 55

ggc ctc gtc ctc aag acc ctc gtc gat ctc ttc cga aat gga gat acc 288
Gly Leu Val Leu Lys Thr Leu Val Asp Leu Phe Arg Asn Gly Asp Thr
60 65 70

agt ctc ctc tcc acc att gag aac tac atc tcc gcc cag gca att gtc 336
Ser Leu Leu Ser Thr Ile Glu Asn Tyr Ile Ser Ala Gln Ala Ile Val
75 80 85

cag ggt atc agt aac ccc tct ggt gat ctg tcc agc ggc gct ggt ctc 384
Gln Gly Ile Ser Asn Pro Ser Gly Asp Leu Ser Ser Gly Ala Gly Leu
90 95 100

ggc gaa ccc aag ttc aat gtc gat gag act gcc tac act ggt tct tgg 432
Gly Glu Pro Lys Phe Asn Val Asp Glu Thr Ala Tyr Thr Gly Ser Trp
105 110 115 120

gga cgg ccg cag cga gat ggt ccg gct ctg aga gca act gct atg atc 480
Gly Arg Pro Gln Arg Asp Gly Pro Ala Leu Arg Ala Thr Ala Met Ile
125 130 135

ggc ttc ggg cag tgg ctg ctt gac aat ggc tac acc agc acc gca acg 528
Gly Phe Gly Gln Trp Leu Leu Asp Asn Gly Tyr Thr Ser Thr Ala Thr
140 145 150

gac att gtt tgg ccc ctc gtt agg aac gac ctg tcg tat gtg gct caa 576
Asp Ile Val Trp Pro Leu Val Arg Asn Asp Leu Ser Tyr Val Ala Gln
155 160 165

tac tgg aac cag aca gga tat gat ctc tgg gaa gaa gtc aat ggc tcg 624
Tyr Trp Asn Gln Thr Gly Tyr Asp Leu Trp Glu Glu Val Asn Gly Ser
170 175 180

tct ttc ttt acg att gct gtg caa cac cgc gcc ctt gtc gaa ggt agt 672
Ser Phe Phe Thr Ile Ala Val Gln His Arg Ala Leu Val Glu Gly Ser
185 190 195 200

gcc ttc gcg acg gcc gtc ggc tcg tcc tgc tcc tgg tgt gat tct cag 720
Ala Phe Ala Thr Ala Val Gly Ser Ser Cys Ser Trp Cys Asp Ser Gln
205 210 215

gca ccc gaa att ctc tgc tac ctg cag tcc ttc tgg acc ggc agc ttc 768
Ala Pro Glu Ile Leu Cys Tyr Leu Gln Ser Phe Trp Thr Gly Ser Phe
220 225 230

att ctg gcc aac ttc gat agc agc cgt tcc ggc aag gac gca aac acc 816
Ile Leu Ala Asn Phe Asp Ser Ser Arg Ser Gly Lys Asp Ala Asn Thr
235 240 245

ctc ctg gga agc atc cac acc ttt gat cct gag gcc gca tgc gac gac 864
Leu Leu Gly Ser Ile His Thr Phe Asp Pro Glu Ala Ala Cys Asp Asp
250 255 260

tcc acc ttc cag ccc tgc tcc ccg cgc gcg ctc gcc aac cac aag gag 912
Ser Thr Phe Gln Pro Cys Ser Pro Arg Ala Leu Ala Asn His Lys Glu
265 270 275 280

gtt gta gac tct ttc cgc tca atc tat acc ctc aac gat ggt ctc agt 960
Val Val Asp Ser Phe Arg Ser Ile Tyr Thr Leu Asn Asp Gly Leu Ser
285 290 295

gac agc gag gct gtt gcg gtg ggt cgg tac cct gag gac acg tac tac 1008
Asp Ser Glu Ala Val Ala Val Gly Arg Tyr Pro Glu Asp Thr Tyr Tyr

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tac gat gct cta tac cag tgg gac aag cag ggg tcg ttg gag gtc aca Tyr Asp Ala Leu Tyr Gln Trp Asp Lys Gln Gly Ser Leu Glu Val Thr 330 335 340			1104
gat gtg tcg ctg gac ttc ttc aag gca ctg tac agc gat gct gct act Asp Val Ser Leu Asp Phe Phe Lys Ala Leu Tyr Ser Asp Ala Ala Thr 345 350 355 360			1152
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cag ctt tcc gct cgc gac ctg acc tgg tct tat gct gct ctg ctg acc Gln Leu Ser Ala Arg Asp Leu Thr Trp Ser Tyr Ala Ala Leu Leu Thr 410 415 420			1344
gcc aac aac cgt cgt aac tcc gtc gtg cct gct tct tgg ggc gag acc Ala Asn Asn Arg Arg Asn Ser Val Val Pro Ala Ser Trp Gly Glu Thr 425 430 435 440			1392
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tcg acc agc aag acc acc gcg act gct agc aag acc agc acc acg acc Ser Thr Ser Lys Thr Thr Ala Thr Ala Ser Lys Thr Ser Thr Thr Thr 490 495 500			1584
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 <213> Aspergillus niger

<220>
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 Asn Glu Ala Thr Val Ala Arg Thr Ala Ile Leu Asn Asn Ile Gly Ala
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 Asp Gly Ala Trp Val Ser Gly Ala Asp Ser Gly Ile Val Val Ala Ser
 25 30 35 40
 Pro Ser Thr Asp Asn Pro Asp Tyr Phe Tyr Thr Trp Thr Arg Asp Ser
 45 50 55
 Gly Leu Val Leu Lys Thr Leu Val Asp Leu Phe Arg Asn Gly Asp Thr
 60 65 70
 Ser Leu Leu Ser Thr Ile Glu Asn Tyr Ile Ser Ala Gln Ala Ile Val
 75 80 85
 Gln Gly Ile Ser Asn Pro Ser Gly Asp Leu Ser Ser Gly Ala Gly Leu
 90 95 100
 Gly Glu Pro Lys Phe Asn Val Asp Glu Thr Ala Tyr Thr Gly Ser Trp
 105 110 115 120
 Gly Arg Pro Gln Arg Asp Gly Pro Ala Leu Arg Ala Thr Ala Met Ile
 125 130 135
 Gly Phe Gly Gln Trp Leu Leu Asp Asn Gly Tyr Thr Ser Thr Ala Thr
 140 145 150
 Asp Ile Val Trp Pro Leu Val Arg Asn Asp Leu Ser Tyr Val Ala Gln
 155 160 165
 Tyr Trp Asn Gln Thr Gly Tyr Asp Leu Trp Glu Glu Val Asn Gly Ser
 170 175 180
 Ser Phe Phe Thr Ile Ala Val Gln His Arg Ala Leu Val Glu Gly Ser
 185 190 195 200
 Ala Phe Ala Thr Ala Val Gly Ser Ser Cys Ser Trp Cys Asp Ser Gln
 205 210 215
 Ala Pro Glu Ile Leu Cys Tyr Leu Gln Ser Phe Trp Thr Gly Ser Phe
 220 225 230
 Ile Leu Ala Asn Phe Asp Ser Ser Arg Ser Gly Lys Asp Ala Asn Thr
 235 240 245
 Leu Leu Gly Ser Ile His Thr Phe Asp Pro Glu Ala Ala Cys Asp Asp
 250 255 260
 Ser Thr Phe Gln Pro Cys Ser Pro Arg Ala Leu Ala Asn His Lys Glu
 265 270 275 280
 Val Val Asp Ser Phe Arg Ser Ile Tyr Thr Leu Asn Asp Gly Leu Ser
 285 290 295
 Asp Ser Glu Ala Val Ala Val Gly Arg Tyr Pro Glu Asp Thr Tyr Tyr
 300 305 310
 Asn Gly Asn Pro Trp Phe Leu Cys Thr Leu Ala Ala Ala Glu Gln Leu
 315 320 325
 Tyr Asp Ala Leu Tyr Gln Trp Asp Lys Gln Gly Ser Leu Glu Val Thr
 330 335 340
 Asp Val Ser Leu Asp Phe Phe Lys Ala Leu Tyr Ser Asp Ala Ala Thr
 345 350 355 360
 Gly Thr Tyr Ser Ser Ser Ser Thr Tyr Ser Ser Ile Val Asp Ala
 365 370 375
 Val Lys Thr Phe Ala Asp Gly Phe Val Ser Ile Val Glu Thr His Ala
 380 385 390
 Ala Ser Asn Gly Ser Met Ser Glu Gln Tyr Asp Lys Ser Asp Gly Glu
 395 400 405
 Gln Leu Ser Ala Arg Asp Leu Thr Trp Ser Tyr Ala Ala Leu Leu Thr
 410 415 420
 Ala Asn Asn Arg Arg Asn Ser Val Val Pro Ala Ser Trp Gly Glu Thr
 425 430 435 440
 Ser Ala Ser Ser Val Pro Gly Thr Cys Ala Ala Thr Ser Ala Ile Gly
 445 450 455
 Thr Tyr Ser Ser Val Thr Val Thr Ser Trp Pro Ser Ile Val Ala Thr
 460 465 470
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 Ser Thr Ser Lys Thr Thr Ala Thr Ala Ser Lys Thr Ser Thr Thr Thr
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 505 510

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 <213> Artificial Sequence

 <220>
 <223> Primer 7258

 <400> 3
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 <210> 4
 <211> 68
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Primer 21401

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 <220>
 <223> Primer 107581

 <400> 5
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 <210> 6
 <211> 88
 <212> DNA
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 <220>
 <223> Primer FAMGIL

 <400> 6
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 tgcgttgct agtcccagca cggataac 88

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 <220>
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 <400> 7
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 <210> 8
 <211> 75
 <212> DNA
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 <220>
 <223> PRIMER FAMGIV

 <400> 8
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gaagactttc gccga

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<210> 9
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<212> DNA
<213> PRIMER RAMGVI

<400> 9
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21

<210> 10
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer FG2

<400> 10
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<210> 11
<211> 27
<212> DNA
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<220>
<223> Primer RG2

<400> 11
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<210> 12
<211> 2602
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<213> ASPERGILLUS NIGER

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<211> 640

<212> PRT

<213> ASPERGILLUS NIGER

<400> 13

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			20					25					30		
Asn	Glu	Ala	Thr	Val	Ala	Arg	Thr	Ala	Ile	Leu	Asn	Asn	Ile	Gly	Ala
		35					40					45			
Asp	Gly	Ala	Trp	Val	Ser	Gly	Ala	Asp	Ser	Gly	Ile	Val	Val	Ala	Ser
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Pro	Ser	Thr	Asp	Asn	Pro	Asp	Tyr	Phe	Tyr	Thr	Trp	Thr	Arg	Asp	Ser
	65				70					75				80	
Gly	Leu	Val	Leu	Lys	Thr	Leu	Val	Asp	Leu	Phe	Arg	Asn	Gly	Asp	Thr
				85					90					95	
Ser	Leu	Leu	Ser	Thr	Ile	Glu	Asn	Tyr	Ile	Ser	Ala	Gln	Ala	Ile	Val
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Gln	Gly	Ile	Ser	Asn	Pro	Ser	Gly	Asp	Leu	Ser	Ser	Gly	Ala	Gly	Leu
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Gly	Arg	Pro	Gln	Arg	Asp	Gly	Pro	Ala	Leu	Arg	Ala	Thr	Ala	Met	Ile
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Gly	Phe	Gly	Gln	Trp	Leu	Leu	Asp	Asn	Gly	Tyr	Thr	Ser	Thr	Ala	Thr
			165					170						175	
Asp	Ile	Val	Trp	Pro	Leu	Val	Arg	Asn	Asp	Leu	Ser	Tyr	Val	Ala	Gln
			180					185					190		
Tyr	Trp	Asn	Gln	Thr	Gly	Tyr	Asp	Leu	Trp	Glu	Glu	Val	Asn	Gly	Ser
		195					200					205			
Ser	Phe	Phe	Thr	Ile	Ala	Val	Gln	His	Arg	Ala	Leu	Val	Glu	Gly	Ser
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Ala	Phe	Ala	Thr	Ala	Val	Gly	Ser	Ser	Cys	Ser	Trp	Cys	Asp	Ser	Gln
	225				230					235					240
Ala	Pro	Glu	Ile	Leu	Cys	Tyr	Leu	Gln	Ser	Phe	Trp	Thr	Gly	Ser	Phe
			245						250					255	
Ile	Leu	Ala	Asn	Phe	Asp	Ser	Ser	Arg	Ser	Gly	Lys	Asp	Ala	Asn	Thr
			260					265					270		
Leu	Leu	Gly	Ser	Ile	His	Thr	Phe	Asp	Pro	Glu	Ala	Ala	Cys	Asp	Asp
		275						280					285		
Ser	Thr	Phe	Gln	Pro	Cys	Ser	Pro	Arg	Ala	Leu	Ala	Asn	His	Lys	Glu
	290					295					300				
Val	Val	Asp	Ser	Phe	Arg	Ser	Ile	Tyr	Thr	Leu	Asn	Asp	Gly	Leu	Ser
	305				310					315					320
Asp	Ser	Glu	Ala	Val	Ala	Val	Gly	Arg	Tyr	Pro	Glu	Asp	Thr	Tyr	Tyr
			325						330					335	
Asn	Gly	Asn	Pro	Trp	Phe	Leu	Cys	Thr	Leu	Ala	Ala	Ala	Glu	Gln	Leu
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Tyr	Asp	Ala	Leu	Tyr	Gln	Trp	Asp	Lys	Gln	Gly	Ser	Leu	Glu	Val	Thr

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370	375	380
Gly Thr Tyr Ser Ser Ser Ser Ser Thr Tyr Ser Ser Ile Val Asp Ala		
385	390	395
Val Lys Thr Phe Ala Asp Gly Phe Val Ser Ile Val Glu Thr His Ala		
405	410	415
Ala Ser Asn Gly Ser Met Ser Glu Gln Tyr Asp Lys Ser Asp Gly Glu		
420	425	430
Gln Leu Ser Ala Arg Asp Leu Thr Trp Ser Tyr Ala Ala Leu Leu Thr		
435	440	445
Ala Asn Asn Arg Arg Asn Ser Val Val Pro Ala Ser Trp Gly Glu Thr		
450	455	460
Ser Ala Ser Ser Val Pro Gly Thr Cys Ala Ala Thr Ser Ala Ile Gly		
465	470	475
Thr Tyr Ser Ser Val Thr Val Thr Ser Trp Pro Ser Ile Val Ala Thr		
485	490	495
Gly Gly Thr Thr Thr Ala Thr Pro Thr Gly Ser Gly Ser Val Thr		
500	505	510
Ser Thr Ser Lys Thr Thr Ala Thr Ala Ser Lys Thr Ser Thr Ser Thr		
515	520	525
Ser Ser Thr Ser Cys Thr Thr Pro Thr Ala Val Ala Val Thr Phe Asp		
530	535	540
Leu Thr Ala Thr Thr Thr Tyr Gly Glu Asn Ile Tyr Leu Val Gly Ser		
545	550	555
Ile Ser Gln Leu Gly Asp Trp Glu Thr Ser Asp Gly Ile Ala Leu Ser		
565	570	575
Ala Asp Lys Tyr Thr Ser Ser Asp Pro Leu Trp Tyr Val Thr Val Thr		
580	585	590
Leu Pro Ala Gly Glu Ser Phe Glu Tyr Lys Phe Ile Arg Ile Glu Ser		
595	600	605
Asp Asp Ser Val Glu Trp Glu Ser Asp Pro Asn Arg Glu Tyr Thr Val		
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<210> 15
 <211> 43
 <212> DNA
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<220>
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 n at positions 22 and 23 is a or g or c or t

<400> 15
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<210> 16
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 <212> DNA
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n at positions 22 and 23 is a or g or c or t

<400> 16
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<210> 17
<211> 43
<212> DNA
<213> Artificial Sequence

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n at positions 22 and 23 is a or g or c or t

<400> 17
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<210> 18
<211> 43
<212> DNA
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<223> primer Hk1-S386X
n at positions 22 and 23 is a or g or c or t

<400> 18
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<210> 19
<211> 43
<212> DNA
<213> Artificial Sequence

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<223> primer Hk1-E389X
n at positions 22 and 23 is a or g or c or t

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n at positions 22 and 23 are a or g or c

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n at positions 22 and 23 is a or g or c or t

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<210> 22
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<212> DNA
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 n at positions 22 and 23 is a or g or c or t

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 <213> Artificial Sequence

 <220>
 <223> primer Hk1-395X
 n at positions 22 and 23 is a or g or c or t

 <400> 23
 tggaaactca cgccgcaagc vnnggctcca tgtccgagca ata 43

 <210> 24
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-G396X
 n at positions 22 and 23 is a or g or c or t

 <400> 24
 aaactcacgc cgcaagcaac vnntccatgt ccgagcaata cga 43

 <210> 25
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-K404X
 n at positions 22 and 23 is a or g or c or t

 <400> 25
 ccatgtccga gcaatacgac vnntctgatg gcgagcagct ttc 43

 <210> 26
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-D406X
 n at positions 22 and 23 is a or g or c or t

 <400> 26
 ccgagcaata cgacaagtct vnnggcgagc agctttccgc tcg 43

 <210> 27
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-E408X
 n at positions 22 and 23 is a or g or c or t

<400> 27
 aatacgacaa gtctgatggc vnnacagcttt ccgctcgca cct 43
 <210> 28
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-L410X
 n at positions 22 and 23 is a or g or c or t
 <400> 28
 acaagtctga tggcgagcag vnnccgctc ggcacctgac ct 42
 <210> 29
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-L423X
 n at positions 22 and 23 is a or g or c or t
 <400> 29
 cctggtctta tgctgctctg vnnaccgcca acaaccgtcg taa 43
 <210> 30
 <211> 44
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-N426X
 n at positions 22 and 23 is a or g or c or t
 <400> 30
 atgctgctct gctgaccgcc vnnaaccgtc gtaactccgt cgtg 44
 <210> 31
 <211> 44
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-N427X
 n at positions 22 and 23 is a or g or c or t
 <400> 31
 ctgctctgct gaccgccaac vnnccgtcgta actccgtcgt gcct 44
 <210> 32
 <211> 46
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-Y402X
 n at positions 21 and 22 is a or g or c or t
 <400> 32
 acggctccat gtcgagcaa nncgacaagt ctgatggcga gcagct 46
 <210> 33
 <211> 41
 <212> DNA

<213> Artificial Sequence
 <220>
 <223> primer Hk2-L234X-sense
 n at positions 20 and 21 is a or g or c or t
 <400> 33
 ctggaccggc agcttcattn nkgccaactt cgatagcagc c 41
 <210> 34
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-A235S-antisense
 <400> 34
 gaacggctgc tatcgaagtt agacagaatg aagctgccgg tc 42
 <210> 35
 <211> 41
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-NF237X-sense
 n at position 20 is a or g or c or t
 <400> 35
 cagcttcatt ctggccaacn atgatagcag ccgttcggc a 41
 <210> 36
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-D235T-antisense
 <400> 36
 ccttgccgga acggctgcta gtgaagttgg ccagaatgaa gc 42
 <210> 37
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-D238S-antisense
 <400> 37
 ccttgccgga acggctgcta gagaagttgg ccagaatgaa gc 42
 <210> 38
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-S239X-sense
 n at positions 21 and 22 is a or g or c or t
 <400> 38
 tcattctggc caacttcgat nncagccgtt ccggcaagga cg 42

<210> 39
 <211> 42
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-S240G-antisense

 <400> 39
 ttgcgtcctt gccggaacga ccgctatcga agttggccag aa 42

 <210> 40
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-S242X-antisense
 n at position 22 is a or g or c or t

 <400> 40
 gggtgtttgc gtccttgcca knacggctgc tatcgaagtt g 41

 <210> 41
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-G243X-antisense
 n at position 22 is a or g or c or t

 <400> 41
 ggagggtgtt tgcgtcctta knngaacggc tgctatcgaa g 41

 <210> 42
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-K244R-sense

 <400> 42
 cgatagcagc cgttccggca gagacgcaaa caccctcctg g 41

 <210> 43
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-T310V-antisense

 <400> 43
 acgggttgcc gttgtagtaa acgtcctcag ggtaccgacc c 41

 <210> 44
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-T310S-antisense

 <400> 44

acgggttgcc gttgtagtaa gagtcctcag ggtaccgacc c 41

<210> 45
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk2-Y311N-sense

<400> 45
 tcggtaccct gaggacacga attacaacgg caaccctgg t 41

<210> 46
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Hk2-Y312Q-antisense

<400> 46
 ggaaccacgg gttgccgttt tggtagctgt cctcagggt a c 41

<210> 47
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk2-Y312N-antisense

<400> 47
 ggaaccacgg gttgccgtta ttgtacgtgt cctcagggt a c 41

<210> 48
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk2-N313T-sense

<400> 48
 ccctgaggac acgtactaca ctggcaaccc gtggttcctg t 41

<210> 49
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk2-N313S-sense

<400> 49
 ccctgaggac acgtactact ctggcaaccc gtggttcctg t 41

<210> 50
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk2-N313G-sense

<400> 50
 ccctgaggac acgtactacg gtggcaaccc gtggttcctg t 41

<210> 51
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-N315Q-antisense

 <400> 51
 aggtgcacag gaaccacggt tggccgttgt agtacgtgtc c 41

 <210> 52
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-N315E-antisense

 <400> 52
 aggtgcacag gaaccacggt tcgccgttgt agtacgtgtc c 41

 <210> 53
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-N315R-antisense

 <400> 53
 aggtgcacag gaaccacggt ctgccgttgt agtacgtgtc c 41

 <210> 54
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-F318Y-antisense

 <400> 54
 cggcagccaa ggtgcacaga taccacgggt tgcgcttgta g 41

 <210> 55
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-Q409P-sense

 <400> 55
 cgacaagtct gatggcgagc cactttccgc tcgcgacctg a 41

 <210> 56
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-D336X-sense
 n at positions 20 and 21 is a or g or c or t

 <400> 56
 cgatgctcta taccagtgn nkaagcagg gtcgttgag g 41

<210> 57
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-K337X-sense
 n at positions 20 and 21 is a or g or c or t

 <400> 57
 tgctctatac cagtgggacn nkcaggggtc gttggaggtc a 41

 <210> 58
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-Q338X-antisense
 n at positions 21 and 22 is a or g or c or t

 <400> 58
 ctgtgacctc caacgacccg nncttggtccc actggtatag a 41

 <210> 59
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-G339X-sense
 n at position 20 is a or g or c or t

 <400> 59
 ataccagtgg gacaagcagn cutcgttggg ggtcacagat g 41

 <210> 60
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-S340X'-antisense
 n at position 21 is a or g or c or t

 <400> 60
 acacatctgt gacctccaaa ntcccctgct tgtcccactg g 41

 <210> 61
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-S340X"-antisense
 n at position 21 is a or g or c or t

 <400> 61
 acacatctgt gacctccaaa nccccctgct tgtcccactg g 41

 <210> 62
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>

<223> primer Hk3-L341X-sense
 n at position 20 is a or g or c or t

<400> 62
 gtgggacaag caggggtcgn uugaggtcac agatgtgtcg c 41

<210> 63
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-K352Q-sense

<400> 63
 tgtgtcgctg gacttcttcc aagcactgta cagcgatgct g 41

<210> 64
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-K352R-sense

<400> 64
 tgtgtcgctg gacttcttca gagcactgta cagcgatgct g 41

<210> 65
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-A352D-antisense

<400> 65
 tagcagcatc gctgtacaga tccttgaaga agtccagcga c 41

<210> 66
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer HK3-A353S-antisense

<400> 66
 tagcagcatc gctgtacaga gacttgaaga agtccagcga c 41

<210> 67
 <211> 42
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-S356P-sense

<400> 67
 acttcttcaa ggcactgtac ccagatgctg ctactggcac ct 42

<210> 68
 <211> 43
 <212> DNA
 <213> Artificial Sequence

<220>

<223> primer Hk3-S356N-sense
 <400> 68
 acttcttcaa ggcactgtac aaugatgctg ctactggcac cta 43
 <210> 69
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-S356D-sense
 <400> 69
 acttcttcaa ggcactgtac gaugatgctg ctactggcac cta 43
 <210> 70
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-D357S-antisense
 <400> 70
 gagtaggtgc cagtagcagc agagctgtac agtgccttga aga 43
 <210> 71
 <211> 41
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-A359S-sense
 <400> 71
 ggcactgtac agcgatgctt ctactggcac ctactcttcg t 41
 <210> 72
 <211> 41
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-T360V-antisense
 <400> 72
 tggacgaaga gtaggtgccca acagcagcat cgctgtacag t 41
 <210> 73
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-G361X-sense
 n at position 21 is a or g or c or t
 <400> 73
 tgtacagcga tgctgctact nctacctact ctctgtccag ttc 43
 <210> 74
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>

<223> primer Hk3-T362R-antisense

<400> 74
gtcgaactgg acgaagagta tctgccagta gcagcatcgc tg 42

<210> 75
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S364X-sense
n at positions 20 and 21 is a or g or c or t

<400> 75
tgctgctact ggcacctacn nktcgtccag ttcgacttat ag 42

<210> 76
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S365X-sense
n at positions 20 and 21 is a or g or c or t

<400> 76
tgctactggc acctactctn nktccagttc gacttatagt ag 42

<210> 77
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S366T-antisense

<400> 77
atgctactat aagtcgaact agtcgaagag taggtgccag ta 42

<210> 78
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S368X-antisense
n at position 23 is a or g or c or t

<400> 78
tctacaatgc tactataagt agnactggac gaagagtagg tg 42

<210> 79
<211> 43
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-T369X-sense
n at positions 20 and 21 is a or g or c or t

<400> 79
ctactcttcg tccagttcgn nktatagtag cattgtagat gcc 43

<210> 80
<211> 43

<212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-S371X-antisense
 n at position 23 is a or g or c or t

 <400> 80
 ttcacggcat ctacaatgct atnataagtc gaactggacg aag 43

 <210> 81
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-S372X-sense
 n at positions 21 and 22 is a or g or c or t

 <400> 81
 cgtccagttc gacttatagt nntattgtag atgccgtgaa gac 43